ATTACHMENT E

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

GEOTECHNICAL INVESTIGATION
NBC UNIVERSAL EVOLUTION PLAN

UNIVERSAL CITY, CITY OF LOS ANGELES AND LOS ANGELES COUNTY, CALIFORNIA

Prepared for:

Universal Studios LLLP, L.P.

March 2010

Shannon & Wilson Project 06-030.1

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OREGON
WASHINGTON

March 2010

Mr. E. Mark Lyum
NBC Universal, Inc.
100 Universal City Plaza
Universal City, California 91608

Subject: **Report of Geotechnical Investigation**
NBC Universal Evolution Plan
Universal City, City of Los Angeles and Los Angeles County, California
for Universal Studios LLLP, L.P
Shannon & Wilson Project 06-030.1

Dear Mr. Lyum:

We are pleased to submit this report presenting the results of our geotechnical investigation for the NBC Universal Evolution Plan in Universal City, Los Angeles.

The findings, conclusions and recommendations developed during this investigation are described in the report.

Sincerely,

Shannon & Wilson, Inc.

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SUMMARY

We have completed our geotechnical investigation as input for the NBC Universal Evolution Plan (the Project) in Universal City, California, for Universal Studios LLLP, L.P. The investigation was authorized to determine the geotechnical conditions, including geologic hazards, within the Universal Studios property.

A geotechnical investigation was performed in 1996 by Converse Consultants West for development of an earlier Environmental Impact Report (EIR) and the information in that prior report was used in preparation of this report. Concurrently with the preparation of this report, we performed an investigation for filing of a Tentative Tract Map within the Mixed-Use Residential Area of the site. The results of that investigation were also utilized in the preparation of this report.

The Project site is located on the north flank of the Santa Monica Mountains at the easterly limits of the San Fernando Valley. The Los Angeles River Flood Control Channel borders the site along the north boundary. The Project site is topographically segmented into three general areas, the relatively flat area in the north/northwest portion of the site, adjacent to the Los Angeles River Flood Control Channel and Lankershim Boulevard; the upper graded plateau in the central and south portions of the Project site, and the Back Lot in the eastern hills that extend along the east side of the Project site. The lower lot and the upper graded plateau are separated by north and northwest facing slopes.

The Project site has a history of many generations of development, including channelization of the Los Angeles River, development of studio, office and Back Lot, and construction of entertainment facilities and infrastructure. Fill and recent alluvium are present adjacent to the Los Angeles River Flood Control Channel, and several generations of fill are present throughout the site. The higher portions of the Project site are underlain by bedded sedimentary bedrock of the Topanga Formation.

Geologic hazards present on the Project site include slope stability within the eastern hillside of the site and liquefaction on the northern flat area. This report describes the geotechnical conditions of the site, and presents recommendations needed to mitigate the potential geologic hazards. It also presents preliminary data for design of foundations, grading, paving and hardscape.

SCOPE

This report presents the results of our geotechnical investigation for the NBC Universal Evolution Plan (the Project). The location of the Project site in relation to the surrounding properties is shown on Figure 1, Vicinity Map. The Project is described on Figure 2, NBC Universal Evolution Plan.

A geotechnical investigation was performed by Converse Consultants West (Converse) for a previous Draft Environmental Impact Report (EIR). The results of the Converse investigation were submitted in their report dated November 14, 1996. That prior report was based on the findings of numerous investigations performed by Converse and other geotechnical firms during the development of the Project. A bibliography, listing the results of the prior investigations within the Project, is presented at the end of this report. Concurrent with this report, we performed an investigation for development of the proposed Mixed-Use Residential Area of the Project and the results of that investigation were submitted in a report entitled: Report of Geotechnical Investigation, Proposed Universal Village Development, Tentative Tract Number 98564, Universal City, Los Angeles, California.

This investigation was authorized to provide geotechnical data for the NBC Universal Evolution Plan. The scope included 1) determining the physical characteristics of the existing soils and bedrock at the Project site, and 2) addressing the geological hazards pertinent to the proposed development. This report presents recommendations to mitigate potential geological hazards as well as preliminary recommendations for designing the foundations, and for grading, paving and stockpile requirements. Our recommendations are based on a site reconnaissance, our geotechnical investigation and the reported conditions from prior aforementioned investigations on the Project site.

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has been prepared for Universal Studios LLLP, L.P. and their design consultants to be used solely in the design of the NBC Universal Evolution Plan. The report has not been prepared for use by other parties, and may not contain sufficient information for purposes of other parties or other uses.

PROJECT DESCRIPTION

PROJECT LOCATION

Universal Studios LLLP, L.P. (the Applicant) is proposing a development program called the NBC Universal Evolution Plan (the Project) as shown on Figure 2, NBC Universal Evolution Plan. The Project is designed to meet the future needs of existing on-site businesses as well as the establishment of a new residential community that contributes to meeting the future housing needs of the eastern San Fernando Valley.

The Project encompasses approximately 391 acres, located two miles north of Hollywood and 10 miles northwest of downtown Los Angeles, in central Los Angeles County. The Project site is also located approximately 1.5 miles south and east of the junction of U.S. Route 101 (Hollywood Freeway) and State Route 134 (Ventura Freeway). The Project site is bounded by the Los Angeles River Flood Control Channel (LAFCC) to the north, the Hollywood Freeway to the south, Barham Boulevard and residences to the east, and Lankershim Boulevard to the west.

The Project site is located within the foothills of the north face of the Santa Monica Mountains and is topographically segmented into three general areas: (1) the relatively flat northern and western portion of the property located adjacent to the LAFCC and Lankershim Boulevard; (2) a plateau in the center of the property (commonly referred to as the "top-of-the-hill"); and (3) an eastern area that includes some sloping terrain along the property's eastern boundary. The Project site has been extensively developed over the past 90 years, although the eastern portion of the Project site is currently underdeveloped.

The Project site is located within two governmental jurisdictions: the City of Los Angeles (approximately 95 acres) and the County of Los Angeles (approximately 296 acres). The property lines are shown on Figure 1, Vicinity Map. The portion of the Project site within City jurisdiction involves primarily three non-contiguous areas surrounding the County portion, with small areas along the northern boundary of the Project site also located within the City of Los Angeles. Proceeding clockwise from the north, these three areas are as follows: (1) the northeastern corner of the Project site along Barham Boulevard; (2) the southeastern corner of the Project site along Barham Boulevard and Buddy Holly Drive; and, (3) the southern and southwestern portion of the Project site, adjacent to the Hollywood Freeway, which also extends to include a limited amount of frontage along the south side of Universal Hollywood Drive as it

extends towards Lankershim Boulevard. The portion of the Project site within County jurisdiction is a contiguous area encompassing most of the northern, central and western portions of the Project site.

EXISTING SETTING OF THE PROJECT SITE

The Project site is presently developed with the following three principal land uses: (1) studio production (movie, television and commercial) and studio office uses, (2) theme park and related entertainment uses, and (3) retail entertainment uses. The Project site currently consists of approximately 4.2 million square feet of development. The Project site also includes numerous production sets and the Tram Tour.

PROPOSED NBC UNIVERSAL EVOLUTION PLAN

The Project, for planning purposes, has been divided into the following four development areas: (1) Entertainment, (2) Studio, (3) Business, and (4) Mixed-Use Residential. These Areas are shown on Figure 3, Area Diagram.

The Project proposes the development of approximately 2.01 million net square feet of new studio production, office, entertainment and retail uses (approximately 2.65 million square feet of new commercial development less approximately 638,000 square feet of demolition) inclusive of 500 hotel rooms. In addition, approximately 2,937 residential dwelling units are proposed to be constructed within the Mixed-Use Residential Area of the Project Site that is located south of Lakeside Plaza Drive.

The Applicant, in addition to the proposed development described above, is seeking approval from the Local Agency Formation Commission (LAFCO) to annex approximately 76 acres from the County's jurisdiction into the City of Los Angeles. This will have the effect of placing the proposed residential development within the Mixed-Use Residential Area under the jurisdiction of the City of Los Angeles. The proposed Project would also involve detachment of approximately 32 acres of the Project site from the City's jurisdiction into the County, for an overall net change of approximately 44 acres. Should the annexation process be completed, approximately 139 acres of the Project site would be located within the City of Los Angeles, and the remaining approximately 252 acres would be located within the County.

The Project will be implemented via two proposed Specific Plans and various other land use entitlements. One proposed Specific Plan will address development within the County portions of the Project site,

namely the Entertainment, Studio and Business Areas; whereas the other proposed Specific Plan will address development within the City portions of the Project site, mainly the Mixed-Use Residential Area.

PROJECT GRADING

Grading for the Project site will require both excavation and the placing of compacted fills. The estimated quantities of earthwork are shown on Figure 4, Conceptual Grading Plan and are summarized in Table 1, Summary of Cut and Fill Quantities.

Table 1, Summary of Cut and Fill Quantities

Area	Cut (cubic yards)	Fill (cubic yards)
Studio Area	139,000	158,000
Entertainment Area	442,000	111,000
Business Area	104,000	19,000
Mixed-Use Residential Area	4,250,000	3,800,000
Total	**4,935,000**	**4,088,000**

Anticipated phasing of the Mixed-Use Residential Area will require stockpiling excavated soils for future use as compacted fill.

PROJECT CONSTRUCTION/PHASING SCHEDULE

The Project would be developed over a period of years in a number of phases. The Applicant anticipates that construction would conclude by 2030. The timing of actual development would be in response to market conditions.

REGULATORY FRAMEWORK

STATE LEVEL

The State of California adopted the 2007 California Building Code, which is based on the 2006 International Building Code, on January 1, 2008.

The County of Los Angeles adopted the 2007 California Building Code on January 1, 2008 as the County of Los Angeles Building Code Volumes 1 and 2.

Together, the provisions in Volumes 1 and 2 of the Los Angeles County Building Code address issues related to site grading, cut and fill slope design, soil expansion, geotechnical investigations before and during construction, slope stability, allowable bearing pressures and settlement below footings, effects of adjacent slopes on foundations, retaining walls, basement walls, shoring of adjacent properties, and potential primary and secondary seismic effects. The County Department of Building and Safety is responsible for implementing the provisions of the Building Code. The County's primary seismic regulatory document is the Safety Element of the County of Los Angeles General Plan, dated December 1990.

The State of California, Division of Mines and Geology, adopted seismic design provisions in Special Publication 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California on March 13, 1997.

The Alquist-Priolo Geologic Hazards Zone Act was enacted by the State of California in 1972 to address the hazard and damage caused by surface fault rupture during an earthquake. The Act has been amended ten times and renamed the Alquist-Priolo Earthquake Fault Zoning Act, effective January 1, 1994. The Act requires the State Geologist to establish "earthquake fault zones" along known active faults in the state. Cities and counties that include earthquake fault zones are required to regulate development projects within these zones.

The Seismic Hazard Mapping Act of 1990 was enacted, in part, to address seismic hazards not included in the Alquist-Priolo Act, including strong ground shaking, landslides, and liquefaction. Under this Act, the State Geologist is assigned the responsibility of identifying and mapping seismic hazards zones.

The California Seismic Safety Commission was established by the Seismic Safety Commission Act in 1975 with the intent of providing oversight, review, and recommendations to the Governor and State Legislature regarding seismic issues. The commission's name was changed to Alfred E. Alquist Seismic Safety Commission in 2006. Since then, the Commission has adopted several documents based on recorded earthquakes, such as the 1994 Northridge earthquake, 1933 Long Beach earthquake, the 1971 Sylmar earthquake, etc. Some of these documents are listed below:

- Research and Implementation Plan for Earthquake Risk Reduction in California 1995 to 2000, report dated December 1994.

- Seismic Safety in California's Schools, 2004, "Findings and Recommendations on Seismic Safety Policies and Requirements for Public, Private, and Charter Schools", report dated December 1994.
- Findings and Recommendations on Hospital Seismic Safety, report dated November 2001.
- Commercial Property Owner's Guide to Earthquakes Safety, report dated October 2006.

Various state and local agencies permit the design and construction and regulate the operation, closure and development of landfills within the State of California. Those agencies include the Regional Water Quality Control Board, the Integrated Waste Management Board, the Department of Toxic Substance Control Board, the Regional Air Resources Board, the Los Angeles County Department of Public Works, the City of Los Angeles Department of Building and Safety, and the South Coast Air Quality Management District.

CITY LEVEL

The City of Los Angeles adopted the 2007 California Building Code, and a series of City of Los Angeles amendments, on January 1, 2008 as the City of Los Angeles Building Code, Volumes 1 and 2. Volume 2 of the Los Angeles City Building Code includes provisions for Foundations, Retaining Walls and Expansive and Compressible Soils in Chapter 18, provisions for Site Work, Demolition and Construction in Chapter 33 and provisions for Grading, Excavation and Fills in a special Chapter 70 developed by and for the City of Los Angeles.

Together, the provisions in Volumes 1 and 2 of the Los Angeles City Building Code address issues related to site grading, cut and fill slope design, soil expansion, geotechnical investigations before and during construction, slope stability, allowable bearing pressures and settlement below footings, effects of adjacent slopes on foundations, retaining walls, basement walls, shoring of adjacent properties, potential primary and secondary seismic effects.

The City of Los Angeles, Grading Division of the Department of Building and Safety, has also adopted their Rules of General Application (RGA), a series of Geotechnical Standards which supplement the requirements of the City of Los Angeles Building Code. The RGAs include specific requirements for seismic design, slope stability, grading, foundation design, geologic investigations and reports, soil and rock testing, and groundwater. The City Department of Building and Safety is responsible for implementing the provisions of the Building Code and Grading Standards.

The City of Los Angeles requires that the firm performing geotechnical investigations, sampling and testing have their laboratory certified by the City, Department of Building and Safety, Materials Control Section.

The City's primary seismic regulatory document is the Safety Element of the City of Los Angeles General Plan, adopted November 26, 1996. The City's regulations incorporate the State's requirements. The objective of the Safety Element is to better protect occupants and equipment during various types and degrees of seismic events. In the Safety Element, specific guidelines are included for the evaluation of liquefaction, tsunamis, seiches, non-structural elements, fault rupture zones, and engineering investigation reports. The City's Emergency Operations Organization (EOO) helps to administer certain policies and provisions of the Safety Element. The EOO is a City department comprised of all City agencies, pursuant to City Administrative Code, Division 8, Chapter 3. The Administrative Code, EOO Master Plan and associated EOO plans establish the chain of command, protocols and programs for integrating all of the City's emergency operations into one unified operation. Each City agency in turn has operational protocols, as well as plans and programs, to implement EOO protocols and programs. A particular emergency or mitigation triggers a particular set of protocols which are addressed by implementing plans and programs. The City's emergency operations program encompasses all of these protocols, plans and programs. Therefore, its programs are not contained in one comprehensive document. The Safety Element goals, objectives and policies are broadly stated to reflect the comprehensive scope of the EOO. As pertains to tsunamis and other flood hazards, the Safety Element refers to the City's Flood Hazard Specific Plan, which addresses areas adjacent to hazards, agency involvement and coordination, and procedures to be implemented during an emergency.

COUNTY LEVEL

The County of Los Angeles adopted the 2007 California Building Code on January 1, 2008 as the County of Los Angeles Building Code, Volumes 1 and 2.

Together, the provisions in Volumes 1 and 2 of the Los Angeles County Building Code address issues related to site grading, cut and fill slope design, soil expansion, geotechnical investigations before and during construction, slope stability, allowable bearing pressures and settlement below footings, effects of adjacent slopes on foundations, retaining walls, basement walls, shoring of adjacent properties, and potential primary and secondary seismic effects. The County Department of Building and Safety is responsible for implementing the provisions of the Building Code. The County's primary seismic

regulatory document is the Safety Element of the County of Los Angeles General Plan, dated December 1990.

VARIATION IN BUILDING CODES

In 2008 the City of Los Angeles and the County of Los Angeles adopted their own building codes, although both codes are based on the 2007 California Building Code. There are differences in the codes between the City and County. Some of the major differences are summarized in Table 2, Comparison of Building Codes.

Table 2, Comparison of Building Codes

Geotechnical Issue	City Code dated 2008	County Code dated 2008
Compaction	Where cohesionless soil has less than 15% finer than 0.005 millimeters, the fill shall be compacted to at least 95%; if the soils have more than 15% finer than 0.005 millimeters the fill shall be compacted to at least 90%.	All fill shall be compacted to a minimum of 90%.
Wall Drainage	Basement wall drains are required unless the walls are designed to resist hydrostatic pressures.	Basement wall drains are not required in well-drained soils
Pile Foundation Interconnection	Interconnection required to resist 10% of vertical load	No requirement

SITE CONDITIONS

The Project site is located on the north flank of the Santa Monica Mountains at the easterly limits of the San Fernando Valley. This area is within the Transverse Ranges Geomorphic Province. The Los Angeles River Flood Control Channel (LAFCC), borders the Project site along the northern boundary.

The Project site is divided into the lower lot in the north and northwest portion, the upper graded plateau in the central and south portions, and the eastern hills that extend along the east side of the Project site. The lower lot and the upper graded plateau are separated by north and northwest facing slopes.

The lower lot is relatively flat at an elevation of approximately 525 to 580 feet above Mean Sea Level (MSL), with a gentle surface gradient north toward the Los Angeles River Flood Control Channel. The lower lot contains sound stages, office space, technical/support space, back-lot sets, transportation services, and parking.

The upper graded plateau ranges in elevation from about 720 to 790 feet MSL, with the highest point near the eastern portion of the plateau in the vicinity of Warehouse #8413. The upper graded plateau has gentle surface gradients to the north, west and south. Prior to grading and development, the upper graded plateau consisted of east-west trending hills with north-south trending ancestral canyons.

The largest of the ancestral canyons bisects the site from the existing Universal Hollywood Drive northward through a closed landfill. The landfill was formed when the north end of this canyon was filled with debris starting in the late 1920s. Landfill operations ceased about 1980. The landfill has been capped, and the face of the slope has been maintained for erosion prevention.

The bulk of the grading activities on the upper graded plateau occurred between 1960 and the early 1980s. These activities consisted of lowering the hills and filling in the canyons until a relatively level topography was achieved. The upper graded plateau contains the remainder of the Entertainment Area (including CityWalk and the Amphitheater) and office space.

The eastern hills are moderately to steeply sloping hillsides ranging in elevation up to 865 feet MSL. These hills have been partially graded in the past and fire roads have been constructed along the southeasterly site limits.

Several man-made water features exist onsite. Falls Lake is located on the eastern portion of the upper graded plateau. Water in Falls Lake is retained by a shallow dam located along the northern edge of the lake. Jaws Lake is located north of Falls Lake on the lower lot at the base of the north facing slope. Park Lake is also located on the lower lot north of Jaws Lake. The Collapsing Bridge pond is located at the north end of the closed landfill. New Falls Lake, which is fed by a man-made waterfall, is located southeast of Falls Lake.

The Los Angeles River which borders the Project site on the north was channelized in the late 1940s. Prior to this, the river had incised meander swings that cut across the north edge of the Project site.

SUBSURFACE INFORMATION

REVIEW OF AVAILABLE INFORMATION

Numerous geotechnical investigations have been performed within the Project site for existing projects over a 60-year period. Our review of previous investigation reports and our recent site investigation formed the basis of our findings, conclusions and recommendations contained in this report. An alphabetical listing of the prior reports, by the firm responsible for preparation of those reports, is presented in the References section at the end of this report.

SITE RECONNAISSANCE

A site reconnaissance was performed as an integral part of our investigation. The reconnaissance included mapping bedrock exposures on the slopes and mapping obvious evidence of slope distress. The results of the mapping are included on Figure 5, Geotechnical Map.

AERIAL PHOTOGRAPHIC REVIEW

Our investigation included a review of vertical, stereo-paired, black and white aerial photographs. This review was performed to evaluate geomorphic conditions that could indicate characteristic features associated with large-scale landslides. Some of these features would include steep slopes associated with a landslide headscarp, deflected natural drainages, transverse topographic fractures, a pronounced protuberant toe, ponded water or other anomalous geomorphic features. The stereo-paired aerial photographs allow the geologist to view the site in three dimensions at thousands of feet above the surface, also referred to as remote sensing. A list of the photographs reviewed for this study are included in the References Section of this report. The results of our review are included in the Landslide Discussion Section.

GEOLOGIC SETTING

GEOLOGIC SETTING

The Project site is located in the southern San Fernando Valley, at the foothills of the Santa Monica Mountains at the northerly mouth of the Cahuenga Pass. The location of the Project site is depicted on Figure 1, Vicinity Map. The San Fernando Valley is an alluvium-filled basin, approximately 12 miles wide and 23 miles long. The alluvium is derived predominantly from bedrock materials comprising the Santa Monica Mountains to the south, the Santa Susana Mountains to the north, the Simi Hills to the west, the San Gabriel Mountains to the northeast, and the Verdugo Mountains to the east. Regionally, the Project site is located in the Transverse Ranges geomorphic province. This province is characterized by east-west trending geologic structure including the nearby Santa Monica Mountains and the east-west trending San Fernando, Santa Susana, Simi, Santa Monica and Hollywood faults.

GEOLOGIC UNITS

General

The Project site is underlain by a variety of geologic units. These units are divided into separate and discrete deposits of differing engineering characteristics that include a closed landfill, man-placed fill, alluvium, colluvium, landslide debris and sedimentary bedrock materials. These units are variable in composition and origin and are described in more detail in the following sections.

Landfill

A relatively large closed landfill is located in the central site limits, just east and north of the Amphitheater structure. The location of the closed landfill is shown on Figure 5, Geotechnical Map. This closed landfill was reportedly filled with debris generated during studio activities between the late 1920s until about 1980. The closed landfill has been capped, and the face of the slope maintained for erosion protection. Landfill materials consisting of an undocumented mix of inert material, mainly construction debris, and restaurant waste have been placed in a north-south trending ancestral canyon to a maximum depth of approximately 130 feet.

Fills (Engineered and Non-Engineered)

Fills have been placed throughout the lower lot, within the upper graded plateau and within the Mixed-Use Residential Area during past grading operations. Some of this fill has been engineered, tested and documented; this fill is identified as Engineered Fill (ef) on Figure 5, Geotechnical Map. Some of the fill has been placed at its current locations without any special compactive effort or geotechnical documentation; this fill is identified as Non-Engineered Fill (nef) on Figure 5.

The non-engineered fills were placed at various times prior to 1950, but as recently as the 1990s. The majority of the engineered fills were placed between the early 1960s and 1981.

The fill materials vary from silty sand to sandy silt with clay. These materials appear to be derived from on-site natural soils and bedrock materials. Fill soils may exist at other locations at the site and may be deeper than encountered in our explorations.

Alluvium/Colluvium Soil

Alluvial soils (alluvium) are natural, fluvial sedimentary deposits typically confined to stream channels, flood plains or alluvial fans. Colluvium (slope wash) is the down-slope accumulation of topsoil, weathered bedrock and other organic materials under the influence of gravity and moisture. These two units often coalesce and are sometimes difficult to separate near their juncture. These deposits are Quaternary age (Pleistocene and Holocene) and usually overlie bedrock and landslide debris. Alluvium has been deposited generally in the lowermost portions of the site near Lankershim Boulevard and along the Los Angeles River Flood Control Channel. Relatively minor deposits have been mapped in the extreme southeasterly portion of the site along Barham Boulevard near the intersection with the Hollywood Freeway. Alluvial consist generally of silty clay, silty sand with interlayered clay and sand.

Landslide Deposits

Features indicative of landsliding were noted at four separate locations designated QlsA, QlsB, QlsC and QlsD. Two of these landslides occupy portions of the Mixed-Use Residential Area on the ridge. These two landslides, designated QlsA and QlsB, were initially recognized during our aerial photographic review as distinct, geomorphic anomalies and were encountered in two and possibly three of our explorations for the Mixed-Use Residential Area.

QlsA:

The larger of these two landslide deposits is located beneath the Warehouse #8413 and occupies an area of approximately 9 acres. The limits of this ancient landslide as interpreted from our aerial photographic review, are depicted on Figure 5, Geotechnical Map, and identified as map symbol QlsA. Based upon observations from geologic downhole logging, the landslide is buried by 4 feet of fill and was observed to consist of very highly weathered sandstone and soft, brecciated shale. The basal landslide rupture surface was observed to be a 4-inch thick very moist, clay gouge layer in contact with competent, hard bedrock materials, below.

An additional, small diameter boring was drilled within the QlsA limits with a hollow stem auger drill rig and may have encountered landslide debris buried by fill materials. It is also possible that grading in this area removed the landslide debris prior to placing of compacted fill. The small diameter boring did not allow for direct observation by a geologist and the presence or absence of the landslide could not be confirmed at this location.

QlsB:

A smaller landslide was recognized northeast of QlsA, upslope of the European Village and beneath Colonial Drive, and occupies approximately 1¼ acres. The limits of this landslide, designated map symbol QlsB, are also depicted on Figure 5. One of our bucket auger borings drilled within the QlsB limits encountered landslide debris to a depth of 21 feet, underlain by hard competent bedrock materials. The basal rupture surface was observed to consist of a 1-inch thick clay gouge layer measured to strike north 30 east and dip 25 degrees to the northwest.

QlsC:

A third possible landslide, designated map symbol QlsC, is located within the adjoining residential development just offsite at the southeast corner of the site. This landslide occupies an area of about half an acre and was recognized in the field and on aerial photographs. This landslide was not explored and is therefore designated a possible landslide that may underlie fill materials within the Project site.

QlsD:

A relatively large landslide feature is located in the north central portion of the Project site. This landslide, designated map symbol QlsD, occupies an area of about 15 acres just east and north of the landfill and south and uphill of the alluvial floor as depicted on Figure 5. The landslide was recognized on stereo-paired, aerial photographs and is best viewed on the 1952 flight.

Physiographically, the landslide is recognized as a well-pronounced geomorphic feature with a characteristic arcuate-shaped headscarp, near-level, mid landslide bench and a protuberant toe that descends to the alluvial-filled valley below. Past grading activities have extensively modified the landslide's original (pre-grading) condition over the years. This area of the Project site is currently used as a warehouse-maintenance facility. Although this landslide was mapped by others, we did not explore this landslide feature during this investigation and, therefore, cannot report on its exact limits and dimensions. QlsD will require exploration during site specific geotechnical investigations.

Bedrock

The Project site is underlain by sedimentary bedrock units of the Topanga Formation consisting of well-bedded sandstone, siltstone and shale. These deposits are marine in origin derived from offshore shoal, turbidite and submarine fan deposits. The bedrock ranges, generally, from moderately hard to moderately soft, but as encountered in our explorations in the ridge area, is locally very hard and well cemented in layers as thick as 6 feet. Surface exposures are typically friable and moderately weathered. Gouged and sheared clay beds were observed along bedding between well-cemented sandstone layers.

Sandstone bedrock units are considered non-expansive. Expansion Index tests on samples of siltstone and shale units from the Mixed-Use Residential Area investigation varied from 12 to 54, indicating that the bedrock varies from non-expansive to a medium expansion potential.

The Topanga Formation is intruded locally by mafic volcanic dikes in the region. The intrusives are generally of a massive diabase composition. Our explorations and observations at the Project site did not encounter volcanic rock units but these units may be encountered during future grading operations.

GEOLOGIC STRUCTURE

Geologic structure at the Project site is exhibited by well-developed bedding planes within the Topanga Formation. Individual Topanga Formation units range from very thickly-bedded (3 to 8 feet) to thinly-bedded (2 to 4 inches). Faulting and folding in the geologic past related to uplift in this portion of the Santa Monica Mountains has warped the geologic structure into a broad, westerly plunging syncline. Bedding planes in the northeasterly portion of the Project site, in the area of the ridge along Barham Boulevard, dip from 20 to 38 degrees to the southwest. Alternatively, bedding planes in the west and southerly portion dip to the northwest from 18 to 40 degrees. Based upon data from our investigation, the synclinal axis trends approximately due west and plunges approximately 20 degrees near the location of the Central Warehouse. Bedding planes west and southerly of the warehouse comprise the southerly limb of the syncline while those north of the axis dip to the southwest. Due to the broad nature of the synclinal fold, the exact location of the fold axis could not be accurately determined but the approximate location and orientation of the fold axis is depicted on Figure 5.

Numerous inactive faults and shears (minor faults) were observed in our bucket auger borings and in surface exposures. These faults are late Miocene and Pliocene Age and are the result of local orogenic activity concurrent with uplift of the Santa Monica Mountains. These fault features are exhibited by offset bedding and dragged (folded) bedding planes and are common in the Topanga Formation. The faults and shears encountered appear to be randomly oriented are generally considered discontinuous and do not display a preferred orientation. Evidence of recent activity was not observed during our site reconnaissance or review of aerial photographs. Previous reports by others do not indicate active faults at the Project site.

Fractures and joints are also common within the Topanga Formation. These joints, as encountered in our explorations, were observed to be widely spaced, tight and stained with iron and manganese oxides and infilled, locally, with carbonates and gypsum.

GROUNDWATER BASIN

Groundwater storage is generally within the deep alluvial deposits that fill the valley floor under confined and unconfined conditions. Groundwater in the lower lot has been measured by others in the past to depths between 20 and 40 feet below the ground surface. Historically, the highest groundwater levels on the Project site have been within 10 feet of the ground surface adjacent to the Los Angeles River on the north side of the Project site (California Division of Mines and Geology 1999). These high water levels existed

prior to the channelization of the Los Angeles River. Based on Project site data, and likely due to the channelization of the river and the control of surface runoff, the high groundwater level is not expected to rise above depths of 15 feet at the Project site.

Borings drilled within the bedrock in the upper graded plateau and within the eastern hills encountered water seepage at various depths. This water seepage is a result of surface infiltration perched within joints and fissures in the bedrock. During grading, temporary excavations and cut slopes may reveal occurrences of groundwater seepage in the natural soils or the bedrock requiring construction dewatering.

GEOLOGIC HAZARDS

FAULTING & SEISMICITY

The Project site is not located within a currently established Alquist-Priolo Earthquake Fault (AP) Zone for surface rupture hazard and there are no known active faults present at the site. The closest AP Zone to the Project site is approximately 5 miles to the northeast. This zone is associated with the Verdugo fault (California Geological Survey, 1979).

The numerous faults in southern California include active, potentially active and inactive faults. Classification for these major groups are based upon criteria developed by the California Division of Mines and Geology (CDMG, now known as the California Geologic Survey) for the AP Zone Act program. By definition, an active fault has ruptured within Holocene geologic time (about the last 11,000 years). Active faults are not known to be located at the Project site and surface rupture from fault plane displacement propagating to the surface is therefore considered remote.

Potentially active faults are those faults that display latest movement during Quaternary Geologic time where Holocene activity cannot be demonstrated. The Quaternary includes the Holocene and Pleistocene Ages and represents the last 1.6 million years of geologic time. Potentially active faults are not considered an imminent fault rupture hazard but the potential cannot be completely dismissed. Inactive faults are those faults where the latest displacement is older than the Pleistocene (Ice Age) and are not considered a surface rupture hazard to the Project site.

The closest active fault to the Project site is the Hollywood fault located approximately 1½ miles to the southeast at the southern base of the Santa Monica Mountains. The Hollywood fault is generally poorly-

defined near the surface and has been located based upon water well, oil well, and geophysical data, as well as near-surface trenching and drilling by numerous investigators. The Hollywood fault is considered active, based upon geomorphic evidence and fault trenching and drill hole correlation studies but has not yet been included within an Alquist-Priolo Earthquake Fault Zone by the State Geologist.

The Project site is approximately 1½ miles Northwest of the boundary of the Elysian Park Fold and Thrust Belt. The Elysian Park fault is actually a blind fault (i.e. A buried fault that does not extend to the surface) capped by a fold and thrust structure. The axial trend of the fold extends approximately 12 miles through the Elysian Park-Repetto Hills from about Silver Lake on the west to the Whittier Narrows on the east. The 1987 Whittier Narrows earthquake (magnitude 5.9) has been attributed to subsurface thrust faults, which are reflected at the earth's surface by a west-northwest trending anticline known as the Elysian Park Anticline, or the Elysian Park Fold and Thrust Belt. The subsurface faults that create the structure are not exposed at the surface and do not present a potential surface rupture hazard; however, as demonstrated by the 1987 earthquake and two smaller earthquakes on June 12, 1989, the faults are a source for future seismic activity. As such, the Elysian Park Fold and Thrust Belt should be considered an active feature capable of generating future earthquakes.

The active Mission Wells segment of the San Fernando fault zone is about 9 miles north of the Project site. Surface rupture occurred along the Tujunga, Sylmar, and Mission Wells segments of the San Fernando fault zone during the February 9, 1971 San Fernando earthquake. The San Fernando fault zone comprises a number of left lateral/reverse frontal faults bounding the southern margin of the San Gabriel and Santa Susana Mountains. This fault slipped on February 9, 1971, causing an earthquake of magnitude 6.4.

The Northridge Thrust fault is an inferred blind thrust fault that is considered the western extension of the Oak Ridge fault. This thrust fault is believed to be the causative fault of the January 17, 1994 Northridge earthquake. The Northridge Thrust is located beneath the majority of the San Fernando Valley. This thrust fault is not exposed at the surface and does not present a potential surface fault rupture hazard. However, the Northridge Thrust is an active feature that can generate future earthquakes.

The Oak Ridge fault is a blind thrust fault located beneath the Santa Susana Mountains approximately 17 miles northeast of the Project site. The fault associated with the 1994 Northridge earthquake is probably part of the Oak Ridge fault system, as it shares many of the characteristics of this fault. This blind thrust

fault is known either as the Pico Thrust, named for the Pico Anticline (a geologic fold it is creating), or as the Northridge Thrust.

A list of known active faults and their distances from the Project site are indicated in Table 3, Major Faults Considered to be Active in Southern California.

Table 3, Major Faults Considered to be Active in Southern California

Fault	Maximum Credible Earthquake			Slip Rate (mm/yr)	Distance From Site (miles)	Direction From Site
Hollywood	7.0	(c)	RO	1.5	1½	SSE
Elysian Park Fold and Thrust Belt	7.1	(c)	RO	1.7	1½	SE
Santa Monica Mountains	7.2	(c)	RO	4.0	2	S
Verdugo	6.75	(d)	RO	0.5	5	NE
Northridge	6.9	(h)	RO	1.5	>5	NW
Newport-Inglewood Zone	7.0	(d)	SS	1.0	7	S
Raymond	6.7	(f)	RO	0.4	9	E
San Fernando	6.8	(g)	RO	5.0	9	N
Sierra Madre	7.3	(c)	RO	4.0	9	NE
Oak Ridge – Pico Thrust	6.7	(g)	RO	4.0	17	NW
Whittier	7.1	(b)	SS	3.0	18	SE
San Andreas (Mojave Segment)	8.2	(e)	SS	30.0	30	NE

(a) Greensfelder, CDMG Map Sheet 23, 1974.
(b) Blake, 1995
(c) Dolan et al., 1995
(d) Mualchin & Jones, 1992
(e) OSHPD, 1995
(f) Wesnousky, 1986
(g) SCEDC
(h) Peterson el al., 1996
SS Strike Slip
NO Normal Oblique
RO Reverse Oblique

Site to fault distances measured using location of late Quaternary fault rupture map by Ziony and Jones, 1989 at a scale of 1:250,000.

A list of known potentially active faults and their distances from the Project site are indicated in Table 4, Major Faults Considered to be Potentially Active:

Table 4, Major Faults Considered to be Potentially Active

Fault	Maximum Credible Earthquake			Slip Rate (mm/yr)	Distance From Site (Miles)	Direction From Site
San Jose	6.7	(e)	RO	0.5	28	ESE
Chino	7.0	(d)	NO	1.0	36	SE
Duarte	6.7	(a)	RO	0.1	30	NE
Rialto-Colton	6.4	(h)	SS	n/d	54	E
Norwalk	6.7	(a)	RO	0.1	22	SE
Coyote Pass	6.7	(c)	RO	0.1	12	SE
Los Alamitos	6.2	(c)	SS	0.1	24	SE
MacArthur Park	6.1	(d)	SS	0.1	6	SW
Overland	6.0	(a)	SS	0.1	12	SW
Charnock	6.5	(a)	SS	0.1	10	SW
Santa Susana	6.9	(e)	RO	6.2	14	NW

(a) Slemmons, 1979
(b) Greensfelder, CDMG Map Sheet 23, 1974
(c) Mark, 1977
(d) Blake, 1995
(e) Dolan et al., 1995
(f) Mualchin & Jones, 1992
(g) OSHPD, 1995
(h) Wesnousky, 1986
SS Strike Slip
NO Normal Oblique
RO Reverse Oblique
n/d Not determined

Site to fault distances measured using location of late Quaternary fault rupture map at a scale of 1:250,000 as documented by Ziony and Jones, 1989

Several earthquakes of moderate to large magnitude (greater than 5.3) have occurred in the southern California area within the last 60 years. A list of these earthquakes is included in Table 5, List of Major Historic Earthquakes. These epicenters are plotted relative to the Project site on Figure 6, Regional Seismicity Map.

Table 5, List of Major Historic Earthquakes

Earthquake	Date of Earthquake	Magnitude	Distance to Epicenter (miles)	Direction to Epicenter
Long Beach	March 11, 1933	6.4	43	SSE
San Fernando	February 9, 1971	6.6	19	NW
Whittier Narrows	October 1, 1987	5.9	16	SE
Sierra Madre	June 28, 1991	5.4	20	E
Big Bear	June 28, 1992	6.4	86	E
Landers	June 28, 1992	7.3	98	E
Northridge	January 17, 1994	6.7	12	W

It should be noted that major earthquakes have not been recorded within historic time on all of the faults considered to be active in southern California. Evidence of the fault's potential activity is based on the fault's rupturing materials younger than about 11,000 years and our historic records are limited to a few hundred years.

Surface traces of the regionally extensive Benedict Canyon fault have been mapped through the westerly portion of the Project site in the Studio Area. This fault is not considered active or potentially active but influences geologic structure regionally and juxtaposes bedrock units along the fault trace. The mapped surface traces of the Benedict Canyon fault is plotted on Figure 5.

The Project site is not exposed to a greater than normal seismic risk than other areas of southern California. However, based on the active and potentially active faults in the region, the Project site could be subjected to significant ground shaking in the event of an earthquake. This hazard is common to southern California and can be mitigated if the buildings are designed and constructed in conformance with applicable building codes and sound engineering practices.

SECONDARY SEISMIC EFFECTS

The site is located approximately 12 miles from the Pacific Ocean shoreline. As a result of this distance, tsunamis are not considered a significant hazard to the Project site. Large bodies of uncovered water such as reservoirs, lakes or ponds are not located above the Project site and hazards related to seiching are not considered a hazard to the Project site. The site is not located within a flood hazard zone as mapped by the County, the City or flood rate insurance maps. Therefore, geologic hazards related to flooding are not considered a significant hazard to the Project site.

SLOPE STABILITY

The Project site is located within areas designated by the state geologist where previous occurrence of landslide movement or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacement to the event that mitigation would be required (California Geologic Survey, 1999). The bedrock consists of well-bedded Topanga Formation sandstone, siltstone and shale. Bedding within the Topanga Formation is well-defined and dips generally to the north, northwest and northeast and where the bedding is oriented toward the slope face, the slopes are subject to landsliding. Our review of aerial photographs and geomorphic analyses indicated features indicative of landsliding at four separate locations. These landslides are discussed above in the Landslide Deposits section.

Buttress fills, apparently placed to stabilize west-facing cut slopes during previous grading in the area of the QlsA landslide, are reported within the east central portion of the Project site. The reported locations and limits of these buttress fills are depicted on Figure 5, Geotechnical Map.

A slope stability hazard exists in the vicinity of the existing landslides and anywhere the bedding could be exposed, particularly the north and west-facing slopes. We have identified the areas of these hazards on Figure 7, Geotechnical Hazards Map.

LIQUEFACTION

Portions of the property are located within areas designated by the state geologist where historic occurrence of liquefaction or local geologic, geotechnical, and groundwater conditions indicate a potential for permanent ground displacement to the extent that mitigation would be required (California Geologic Survey, 1999). Liquefaction potential is greatest where the groundwater level is shallow, and loose sands or silts occur within a depth of about 50 feet or less. In general, liquefaction potential decreases as grain size and clay and gravel content increase. As ground acceleration and shaking duration increase during an earthquake, liquefaction potential increases.

The north side of the Project site adjacent to the Los Angeles River Flood Control Channel is underlain by loose to medium dense granular soils and the groundwater is potentially within 50 feet of grade. The soils in this area are susceptible to liquefaction. This potentially liquefiable zone varies from about 100 feet to over 800 feet south of the river and is within the non-engineered fill (nef) and the recent alluvium (Qal) as shown on Figure 3, Geotechnical Map.

The potential for seismic settlement resulting from liquefaction is estimated to vary from less than one inch to greater than one foot. The greatest amount of settlement would be expected to occur immediately adjacent to the river and would decrease to the south. We have identified the areas of liquefaction potential and have shown them on Figure 4, Geotechnical Hazards Map. Site specific geotechnical investigations, including detailed liquefaction studies, will be required for any new construction within the areas identified on Figure 4 as areas of liquefaction potential.

NON-ENGINEERED FILL

The non-engineered fills may be weak and compressible, particularly with the addition of water. These fills are subject to settlement and are not suitable for support of foundations, slabs on grade, paving or new compacted fills. Cut slopes in these fills are subject to sloughing and failure because of their low shear strength.

CLOSED LANDFILL

The closed landfill is a deep, non-engineered fill with varying amounts of organic and inorganic debris. The landfill appears to have been constructed prior to the state's permitting and closing requirements. Similar to other non-engineered fills, the landfill is subject to settlement, made greater by the depth and decomposable organic matter. Methane gases are generated by the decomposition of the organic matter.

EXPANSIVE SOILS

The clay soils within the natural alluvium and colluvium, within the fill soils and excavated bedrock are subject to expansion and shrinkage resulting from changes in the moisture content. Tests on samples of the clays indicate that the Expansion Index can range up to about 60, which is a medium expansion potential.

FLOODING AND INUNDATION

The Project site is not located in a County or City of Los Angeles flood or inundation hazard zone. The Los Angeles River Flood Control Channel borders the northerly site limits but has been contained and concrete lined and is not considered a flood hazard with respect to the Project site. The Project site is not located in close proximity to large bodies of water and the potential adverse effects of seiching is unlikely.

Oil Wells

According to maps prepared by the State of California Department of Conservation, Division of Oil, Gas and Geothermal Resources, abandoned or active oil wells are not located within or near the Project site. The Project site is not located with the limits of a known oil field.

METHANE GAS

The Project site is not located within a City of Los Angeles Methane Hazard Zone. In addition, the Project site is not located within a known oil field and oil or gas wells are not reported to be located within or near the site limits. However, methane gas may be present in the closed landfill in the central portion of the site. The methane may migrate beyond the closed landfill.

SUBSIDENCE

The Project site is not located within an area of known subsidence (ground surface settlement) associated with fluid withdrawal (groundwater or petroleum), peat oxidation, or hydrocompaction. Historically, the highest groundwater levels have been within 10 feet of the ground surface prior to channelization of the Los Angeles River. After channelization the historic high groundwater level is expected to be about 15 feet. Groundwater could be encountered within excavations that extend more than about 15 feet below ground surface and require dewatering.

If dewatering is required during construction, dewatering is not anticipated to lower groundwater across any substantial distance and any related settlement is expected to be minimal and localized within the area of construction. The settlement would occur quickly and be completed shortly after completion of the excavation. Any potential settlement related to long-term dewatering for building operation would be less than, and already accounted for in, the construction dewatering settlement. Recommendations for the efficient design of any required dewatering systems should be included in the site-specific geotechnical investigations and recommendations for new construction.

Subsidence is, therefore, not considered a significant impact to the Project site.

OTHER HAZARDS OR IMPACTS

SEDIMENTATION AND EROSION

If the Mixed-Used Residential Area is annexed to the City of Los Angeles, it should be anticipated that it may be included within a City of Los Angeles designated Hillside Grading Area, requiring that the stability of all slopes be evaluated. The grading requirements as designated in the City or County building codes, as applicable, for drainage and planting of slopes should be followed. The differences in the building codes are presented in a following section, Variations In Building Codes.

In addition, grading, excavation, and other earth-moving activities could potentially result in erosion and sedimentation. For any grading performed in the “rain season”, generally November to April, provisions will need to be made to control erosion and an erosion control plan must be submitted to the appropriate building department.

LANDFORM ALTERATION

The planned grading within the Mixed-Use Residential Area of the Project site will excavate into an existing north-south trending ridge. The excavation will not, however, reduce the overall height of the ridge at its highest point. Runoff following rain periods is seasonal and limited to brief periods following heavy rains. The grading would not alter any significant canyons, ravines or outcrops. Therefore, no distinct and prominent geologic or topographic features would be adversely affected by the Project.

MINERAL RESOURCES

There are no known economically extractable deposits of mineral resources such as building stone, clay or light-weight aggregate beneath the Project site. Therefore, the Project site is not anticipated to have an impact on mineral resources in the area.

COMPACTION CRITERIA

The County of Los Angeles requires that all compacted fills be placed to a minimum of 90% compaction. The City of Los Angeles requirement depends on the soil type. Cohesionless sands are to be compacted to a minimum of 95% and cohesive silts and clays are to be compacted to a 90% minimum. Both agencies use the same maximum density standard, the ASTM D1557 method and other compaction criteria are comparable.

DRAINAGE AND BENCHING REQUIREMENTS

The County of Los Angeles requires an 8-foot wide drainage terrace on all cut or fill slopes at 25-foot vertical intervals and a 20-foot wide terrace at the midpoint on all cut and fill slopes more than 100 feet in height. The City of Los Angeles also requires an 8-foot wide interceptor terrace on all cut or fill slopes at 25-foot vertical intervals, but requires a 30-foot wide terrace at the midpoint on all cut and fill slopes more than 100 feet in height.

SET-BACK REQUIREMENTS

Both the City and County have a requirement for building setback at the toe of slopes equal to one-half the slope height; the County has a 20-foot maximum distance and the City has a 15-foot maximum distance. At

the top of the slope, the City has a requirement that the horizontal distance between the face of the slope and the base of the building foundation be equal to one-third the slope height, but not more than 40 feet.

IMPACT OF CODE VARIATION

The design for a building project must be in accordance with the applicable building code, depending upon the municipality in which the building project site is located. While there could be differences on the design and construction adherence to either code would mitigate any geologic hazard.

HAZARD MITIGATION

GENERAL

Each of the geologic hazards present on the Project site (Slope Stability, Liquefaction, Non-Engineered Fill, and Closed Landfill) are shown on Figure 7, Geotechnical Hazards Map. Mitigation of these hazards are discussed in this section. Foundation and grading requirements and water runoff infiltration are also discussed.

Comprehensive geotechnical investigations should be prepared for each project as that term is defined in the proposed City and County Specific Plans to the satisfaction of the applicable jurisdiction standard. Each of the hazards described in this report will need to be investigated in detail and recommendations will need to be developed prior to proceeding with design.

Geotechnical observation and testing will be required during the placement of new compacted fills, foundation construction, buttresses, stabilization fills, ground improvement and any other geotechnical-related construction for each project. The geotechnical firm performing these services will need to be approved by the City of Los Angeles, for work within the city limits.

SLOPE STABILITY

A slope stability hazard is present for most west, northeast and north-facing cut slopes. The hazard could be mitigated by either reorienting the cut slopes, reducing the slope angle to the angle of the bedding or flatter, or by construction of buttress and stabilization fills. Reducing the slope angles would require ratios of about 3:1 (horizontal to vertical). There does not appear to be sufficient space to permit this alternative and we, therefore, recommend the use of buttress and stabilization fills. Site-specific geotechnical investigations to

the satisfaction of the applicable jurisdiction's standards should be performed for design of all cut and fill slopes. Typical recommendations for design of buttress and stabilization fills are presented in a following section, Grading Requirements.

The natural slopes at the north-eastern portion of the Project site, where the Project site is adjacent to Barham Boulevard, are stable from deep-seated failures, but these slopes are steep with inclinations as steep as ½:1, up to about 50 feet in height, and are subject to rockfall hazards. This surficial stability hazard could be mitigated by construction of a slough wall and a rockfall catchment fence at the base of the slope adjacent to Barham Boulevard. The catchment fence should be located on top of the wall.

The slough wall should be at least four feet in height. There should be at least four feet of horizontal distance between the slough wall and the face of the slope to permit access by a small skiploader for periodic clearing. The slough wall should be designed to support a lateral pressure equal to the pressure developed by a fluid with a density of 50 pounds per cubic foot. A rock catchment fence should be placed on top of the slough wall for an additional 3 feet to attain a minimum height of 7 feet from the adjacent grade. There should be at least 8 feet of horizontal distance between the top of the fence and the adjacent slope.

This surficial stability hazard could also be mitigated with rock-netting placed over the face of the slope. The rock netting could be used alone or in conjunction with the slough wall and catchment fence.

LIQUEFACTION

The liquefaction hazard is most prevalent within the natural alluvial deposits in the lower lot along the Los Angeles River Flood Control Channel. The location of the areas subject to liquefaction hazards are shown on Figure 7. In general, any areas where the hazard is defined as High, where there is the potential for more than about 4 inches of settlement resulting from liquefaction, will require mitigation for new construction. Mitigation could include ground improvement or deep foundations extending through the potentially liquefiable soils and structurally-supported floor slabs.

Areas with a Moderate potential of liquefaction, where there is between one and four inches of settlement potential, could be mitigated by special foundation design procedures, such as extra reinforcement and strengthening of building foundations and floor slab systems. Areas with low potential for liquefaction may not require any special foundation treatment or ground improvement.

The liquefaction hazard can be mitigated by excavation and recompaction of the potentially liquefiable zone or by in-situ densification. Excavation and recompaction does not appear reasonable for all of the soils immediately adjacent to the river, because the zone extends well below the existing river channel and below groundwater. Site-specific liquefaction hazard studies will be required for new construction within the liquefaction hazard area.

EXPANSIVE SOILS

Expansive soils with a medium expansion potential are present on the Project site. These soils present a hazard to lightly loaded concrete slabs on grade, where the slab can move vertically with changes in the soil's moisture content. This hazard can be mitigated by excavation and replacement of the expansive materials with a soil with a low or non-expansive potential. In general, it should be anticipated that one foot of non-expansive material will be required. The excavated materials can be used in the compacted fills below depths of one foot and removal from the Project site will not be required.

NON-ENGINEERED FILLS

Non-engineered fills are not suitable for support of new fills, foundations, concrete slabs on grade, or paving. During construction, the non-engineered fills will need to be excavated, and replaced as compacted fill properly benched into suitable materials. The limits of the non-engineered fills to be removed and recompacted are shown on Figure 5. In general, most of the excavated materials can be reused in the compacted fills. The suitability of the materials will need to be confirmed during the comprehensive geotechnical investigation.

LANDFILL

Any structures located over the landfill will require deep foundation extending through the landfill and into the underlying bedrock. Downdrag loads resulting from decomposition and settlement of the landfill will need to be added to the design loads on the piles.

Methane gas may be present in the landfill. The methane may also migrate beyond the limits of the landfill. Any new construction located within 1,000 feet of the landfill may require evaluation by a methane specialist and mitigation for methane gas pursuant to County requirements. In addition, if the Mixed-Use Residential Area is annexed into the City, pursuant to the City Municipal Code, the City may also require

mitigation for methane gas for new construction where a methane intrusion hazard exists. A methane specialist should be retained prior to new construction to evaluate the methane hazard and to provide recommendations to mitigate any methane impact, consistent with the applicable County and City requirements.

FOUNDATION REQUIREMENTS

General

New structures should be supported on foundations developing their support either within the bedrock or properly compacted fill. The capability of the existing engineered fills to support new foundations will need to be verified during each project's comprehensive geotechnical investigation. In areas of non-engineered fill and in the areas of the Landfill, deep foundations carried through the non-engineered fill could be used, or the non-engineered fill could be excavated and replaced with properly compacted fill and foundations could be established in the compacted fill.

In areas prone to liquefaction, if the hazard is not mitigated, foundations would need to be carried through the liquefaction potential zone, or deep foundations would be needed.

The limits of the bedrock, engineered fill and non-engineered fill are shown on Figure 5, Geotechnical Map.

Where proposed buildings are to be supported on spread footings in compacted fill, the bedrock should be overexcavated as necessary to achieve at least 3 feet of compacted fill beneath the bottoms of the footings. Any retaining walls planned around the property walls may also be supported on spread footings in either the compacted fill or the bedrock.

Footings in Bedrock

Spread footings carried at least 1 foot into the bedrock and at least 2 feet below the lowest adjacent grade or floor level can be designed to impose a net dead-plus-live load pressure of 10,000 pounds per square foot. A one-third increase in the bearing value can be used for wind or seismic loads.

Footings in Compacted Fill

Spread footings underlain by at least three feet of compacted fill and carried at least 2 feet below the lowest adjacent grade or floor level can be designed to impose a net dead-plus-live load pressure of 3,000 pounds per square foot. A one-third increase in the bearing value can be used for wind or seismic loads.

Pile Foundations

There are a variety of pile foundations that could be used where it is necessary to carry foundation support through a weak or potentially liquefiable deposit or through the landfill. These options could include:

- Drilled cast-in-place pile foundations.
- Driven friction or end-bearing piles.
- Vibrated friction or end-bearing piles.
- Auger cast piles.
- Displacement auger-cast piles.

The presence of groundwater or potentially caving soils (such as the alluvium) may limit the use of conventional drilled cast-in-place piles. It is our understanding, that because of noise and vibrations associated with driven piles, the owner does not plan to use driven piles. The auger-cast piles and the displacement auger-cast piles could be used in a variety of soil and bedrock materials and may be an economical type of deep pile foundation without the disadvantages of excessive noise, vibration or damage to the channel walls. It may be possible to develop downward pile capacities of 150 to 250 kips for 16- to 24-inch diameter piles 40- to 50-feet in length.

Site Coefficient and Seismic Zonation

The structures located in the upper plateau portion of the site can be designed to resist earthquake forces following the 2008 Los Angeles City or Los Angeles County Building Code. The Site Classification may be assumed to be a Site Class C, Very Dense Soil and Soft Rock Profile.

The structures located in the lower plateau portion of the site can be designed to resist earthquake forces following the 2008 Los Angeles City or Los Angeles County Building Code. The Site Classification may be assumed to be a Site Class E, Soft Soil Profile.

The mapped maximum considered earthquake spectral response accelerations, Ss and S1, should be taken as 1.515 and 0.600, respectively, according to the 2008 Los Angeles County Building Code. The site coefficients, Fa and Fv, may be determined for these spectral response acceleration values and for a Site Class C or E, accordingly.

GRADING REQUIREMENTS

General

The placing of all fills will need to be properly engineered and constructed. All vegetation within the limits of grading will need to be removed and existing fills and any unsuitable soils will need to be excavated prior to fill placement.

Grading within the hillside areas will need to address the stability of the slopes. Where favorable bedding exists, the slopes could be constructed at a 2:1 (horizontal to vertical) inclination. If the bedding dips unfavorably out of the slopes, the slopes should either be flattened to the angle of the bedding (or flatter), or the slopes will require stabilization. The degree of stabilization will depend on the orientation of the bedding with respect to the final slope and the depth of the excavation. Where the bedding dips out of the slopes, buttress fills will be required. If the bedding is approximately parallel to the slopes, thinner stabilization fills will suffice. The design of the buttress or stabilization fills will need to be included to the satisfaction of the applicable jurisdiction in the comprehensive investigations prior to new construction in hillside areas.

Buttress and Stabilization Fills

The actual dimensions of the buttress fills will need to be determined when the Planning Subarea elevations and the depth of any building subterranean construction are known. For planning purposes, the buttress fills should be constructed to a width equal to one-half the height of the slope, or to a minimum width of 20 feet. Backdrains will be required behind all buttress and stabilization fills. Compacted fill slopes may be constructed at 2:1. Slopes should be overfilled 5 horizontal feet and trimmed back to a compacted core.

Within the Mixed-Use Residential Area, buttress fills will be required on most of the west facing cut slopes. Stabilization fills will be required on most of the north-facing cut slopes. The buttress and stabilization fill design must also consider subterranean construction in front of these fills. Typical buttress fill details are shown on Figure 8, Typical Buttress Fill Design Criteria. Typical stabilization fill details are shown on Figure 9, Typical Stabilization Fill Design Criteria. The dimensions shown on these details will need to be determined during design.

Compaction

Any required fill should be placed in loose lifts not more than 8 inches thick and compacted to the standard as determined by the ASTM Designation D1557 method of compaction. The fill will need to be compacted in accordance with the City or County of Los Angeles requirements as applicable. Cohesive fills should be compacted to 90%. Granular, non-cohesive soil should be compacted to at least 95%. Where deep fills are required a greater degree of compaction may be required to reduce the settlement of the completed fills.

We anticipate shrinkage factors of 10% and 15% when compacting the fill/alluvium to 90% and 95%, respectively. Similarly, bedrock will bulk 5% and 0% when excavated and recompacted to 90% and 95%.

Material for Fill

The on-site excavated materials, less any debris or organic matter, can be used in required fills. However, because of their expansive characteristics, the on-site clayey soils should not be used within one foot of the subgrade for floor slabs, walks, and other slabs. Cobbles larger than 4 inches in diameter should not be used in the fill. Any required import material should consist of relatively non-expansive soils with an Expansion Index of less than 35. The imported materials should contain sufficient fines (binder material) so as to be

relatively impermeable and result in a stable subgrade when compacted. All proposed import materials should be approved by the geotechnical consultant-of-record prior to being placed at the site.

Stockpiled Fill

The grading for the Mixed-Use Residential Area may be performed in phases. If a phased development is planned, up to about 450,000 cubic yards of excavated material could be stockpiled on undeveloped portions of future phases. If the stockpile will remain in place after completion of adjacent developments, the exterior slopes of the stockpile should be treated as permanent slopes with drainage requirements consistent with the requirements of the City of Los Angeles or the County of Los Angeles, as applicable.

If the stockpiled fill is to be in place for less than one year or if the stockpile is less than 40 feet in height, the fill would not need to be compacted and tested, but the stockpiled material should be placed in lifts not more than two feet in thickness and rolled with heavy compaction equipment.

If the stockpiled fill is greater than 40 feet in height, the outer portion of the fill, with a width equal to at least the height of the fill, should be compacted to at least 90%. The interior core of the stockpile need not be compacted to the 90% minimum, but should at least be track-rolled with heavy equipment.

The side slopes of the stockpile fill, less than 40 feet in height, may be constructed as steep as 1½:1 (horizontal to vertical). Stockpile fill more than 40 feet in height should not be constructed steeper than a 2:1 slope inclination.

If the stockpiled fill were to be in place for less than one year and if the stockpile were less than 40 feet in height, the normal City requirements for rainy weather erosion protection should be sufficient. This means that the stockpile should be surrounded by sandbags and all runoff should be collected into approved storm water collection devices.

If the stockpile will be in place for more than one year or if the stockpile will be more than 40 feet in height, drainage terraces should be provided on all slopes. The terraces should be at least 8 feet in width and spaced no further than 25 feet apart vertically.

WATER RUNOFF INFILTRATION AND BIO-SWALE

Infiltration of site runoff water into compacted fills can have a long-term detrimental effect on the strength and compressibility of the compacted fills. The water can also have an adverse effect on the stability of the slopes and will need to be removed by subdrains for new buildings from behind building basement walls and retaining walls to prevent development of damaging hydrostatic pressures. Furthermore, the subsurface materials have a relatively low permeability and will not accept large quantities of runoff.

Vegetative swales/filter strips, where runoff is directed along a swale or across a vegetative surface for treatment, may result in partial retention and vegetative uptake and limited percolation of runoff. All vegetated treatment facilities should be constructed with underdrains and, if needed, liners to restrict infiltration to the underlying compacted soils (some areas may not need to include a liner as these soils will effectively act as a liner until perforated pipes are able to drain percolated waters). Collected and treated water should be either discharged to the storm drain systems or potentially used for irrigation elsewhere on the Project site.

RECLAIMED WATER TANK

A reclaimed water tank is planned in the Mixed-Use Residential Area. The tank can be as large as 120 feet in diameter and 10 feet deep and of reinforced concrete or steel construction with up to 850,000 gallon capacity. The conceptual location is on the east side of the Project site at the top of a 150-foot high graded slope. If constructed at this location, the tank would be buried, with the top of the tank exposed and the base will be set back about 30 feet from the face of the slope. It is possible that the reclaimed water tank could be sited at other locations within the Mixed-Use Residential Area. The reclaimed water tank could also be smaller in size or consist of multiple tanks ranging from 25,000 gallons to 250,000 gallons.

The slope adjacent to the conceptual location is potentially unstable and will be stabilized with a buttress fill. The buttress fill will be equipped with a backdrain. The tank will be constructed at the top of the buttress fill. We recommend that the base of the tank consist of a reinforced concrete foundation and that the grading for the buttress extend beneath the entire limits of the tank. If these provisions are made, then this site would be acceptable for the tank.

Drainage should be provided around and beneath the tank. The drainage should consist of a perforated pipe behind the tank walls with gravel backfill and a subdrain beneath the base of the tank. The subdrain should

consist of a layer of permeable gravel with drainage pipes. The drainage pipes and the wall drain should drain to an approved drainage device. With those provisions at the location planned, the tank will not adversely affect the stability of the slope. Because the tank is situated at the top of a high slope, we recommend that provisions be made to capture any leakage resulting from a tank rupture with that leakage directed to an appropriate collection system.

Alternative locations could include elsewhere on graded pads within the Project site either on or adjacent to the slopes or adjacent to the Los Angeles River Flood Control Channel. Other potential geologic hazards could include liquefaction, or the presence of non-engineered fills. If any geologic hazards at these potential sites are mitigated in accordance with the findings, conclusions and recommendations in this report, the locations would then be suitable for siting of the water tank. Detailed geotechnical recommendations will be needed prior to the tank's final design and construction.

Other subterranean reclaimed water tanks may be located in the Studio, Entertainment or Business Areas. These tanks would be 50,000 gallons or less in size and installed pursuant to regulatory requirements. Detailed geotechnical recommendations will be needed prior to the final design and construction of each tank.

PAVING

The required thicknesses of paving and base will depend on the expected wheel loads and volume of traffic (Traffic Index or TI). Assuming that the paving subgrade will consist of the on-site or comparable soils with an R-value of 25 and compacted to at least 90% as recommended, the minimum recommended paving thicknesses are presented in Table 6, Recommended Paving Thicknesses.

Table 6, Recommended Paving Thicknesses

Traffic Use	Traffic Index	Asphalt Paving	Base Course
Parking	5.0	4 inches	4 inches
Drives	6.0	4 inches	8 inches
Street	7.0	5 inches	9 inches
Street	8.0	5 inches	12 inches

The base course should conform to requirements of Section 26 of State of California Department of Transportation Standard Specifications (Caltrans), latest edition, or meet the specifications for untreated base as defined in Section 200-2 of the latest edition of the Standard Specifications for Public Works Construction (Green Book). The base course should be compacted to at least 95%.

HARDSCAPE

The on-site clay soils are expansive and relatively impermeable. Irrigation water could become trapped within the upper soils of landscaped areas particularly if the landscaped areas are covered with permeable planting materials. This trapped water can move laterally beneath slabs, curbs and paving. We recommend that all concrete slabs on grade be underlain by at least one foot of non-expansive soil with an Expansion Index less than 35 to minimize the expansion potential. In addition, we recommend that consideration be given to providing subsurface cutoff walls between landscaped and hardscape areas. The cutoff walls could consist of a concrete-filled trench at least six inches wide and two feet deep. The cutoff walls should extend at least six inches below any adjacent granular non-expansive material or the paving base course. Drain lines would be desirable adjacent to the landscaping.

It should be noted that even with provisions to protect against movement, some movement could occur due to expansive soils. The geotechnical engineer-of-record should be provided with a copy of the hardscape and landscaping plans for review prior to final design.

In the grading section of this report, we recommend that in all areas requiring structural fill, the fill be compacted to at least 90%. In areas to be landscaped, the level of compaction could be reduced to 85%, but we suggest that this lower level of compaction be limited to the upper three feet to reduce the potential for areal settlement as the areas become watered. Compaction to at least 90% will still be required beneath planter walls, sidewalks, paving and hardscape.

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Yerkes, R.F., et al., 1965, Geology of the Los Angeles Basin, California – An Introduction, U.S. Geol. Survey Prof. Paper 420-A, 57p.

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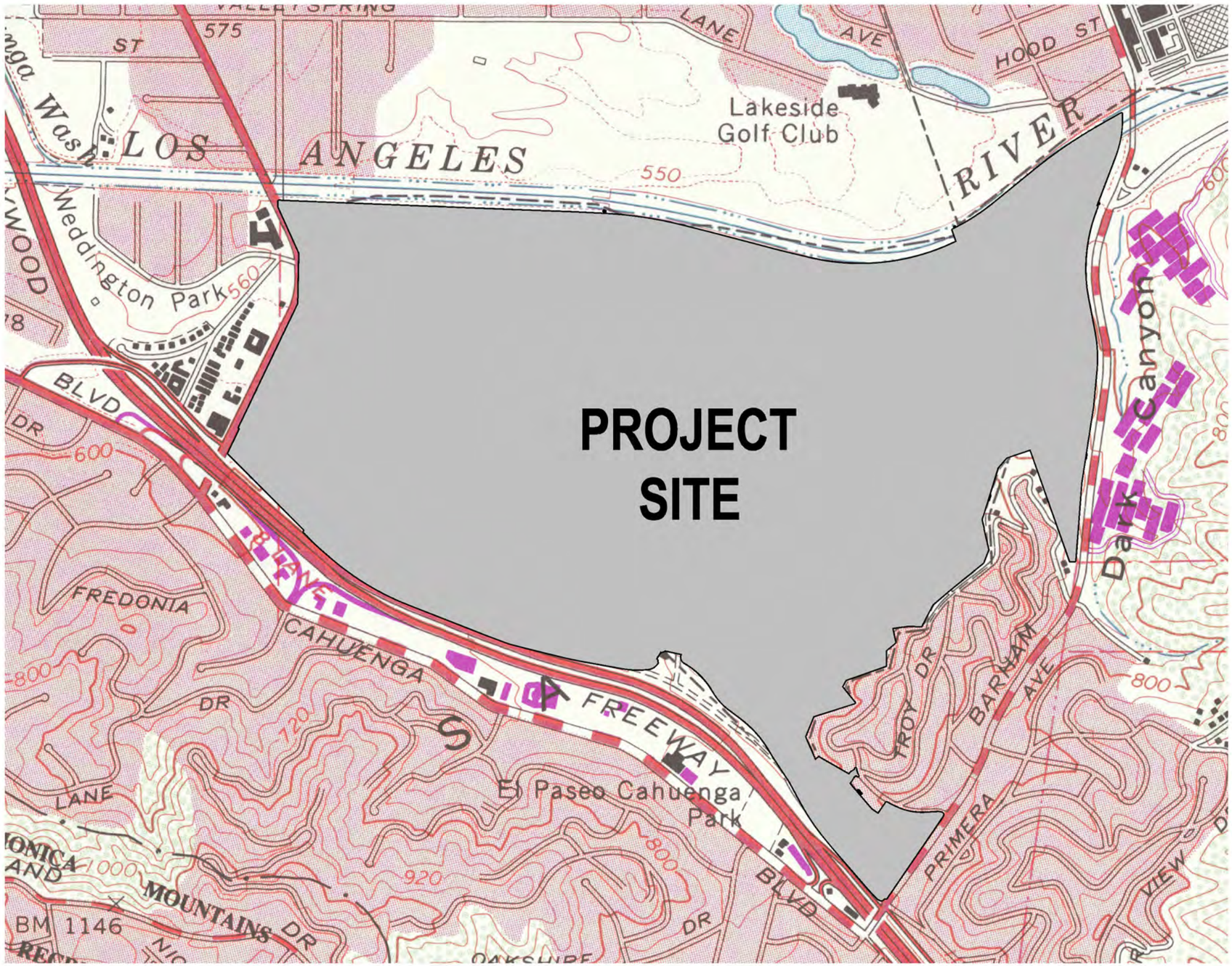
AERIAL PHOTOGRAPHS

Stereo-paired, black and white aerial photographs were reviewed to evaluate geomorphic conditions that could indicate characteristic features associated with large scale landslides. A list of the photographs reviewed is presented below:

AERIAL PHOTOGRAPHS

Photograph Date	Flight/Frame	Scale
10/18/98	C127-24-54-55	1 inch = 2,000 feet
6/10/95	C113-24-236-237-235	1 inch = 2,000 feet
5/10/93	C88-23-229-230	1 inch = 2,000 feet
5/25/90	C81-8-28-29-27	1 inch = 2,800 feet
7/7/88	19291-92-93	1 inch = 2,200 feet
1/27/86	F-492-493	1 inch = 2,800 feet
5/12/79	FCLA-4-205-206	1 inch = 2,800 feet
11/7/76	76162-208-09-10	1 inch = 2,000 feet
4/20/72	107-12-17-18	1 inch = 4,000 feet
1/30/70	60-3-70-71-72	1 inch = 4,000 feet
3/4/69	25-16-71-72-73	1 inch = 1,000 feet
11/4/52	11-4K-151-152	1 inch = 1,666 feet
10/27/54	20K-43-44-45	1 inch = 1,666 feet



800' 400' 0 800' 1600'

GRAPHIC SCALE

REFERENCE: TOPOGRAPHIC MAP BURBANK 7½' QUADRANGLE MAP BY USGS 1996

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VICINITY MAP

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FIGURE 1

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NBC UNIVERSAL EVOLUTION PLAN

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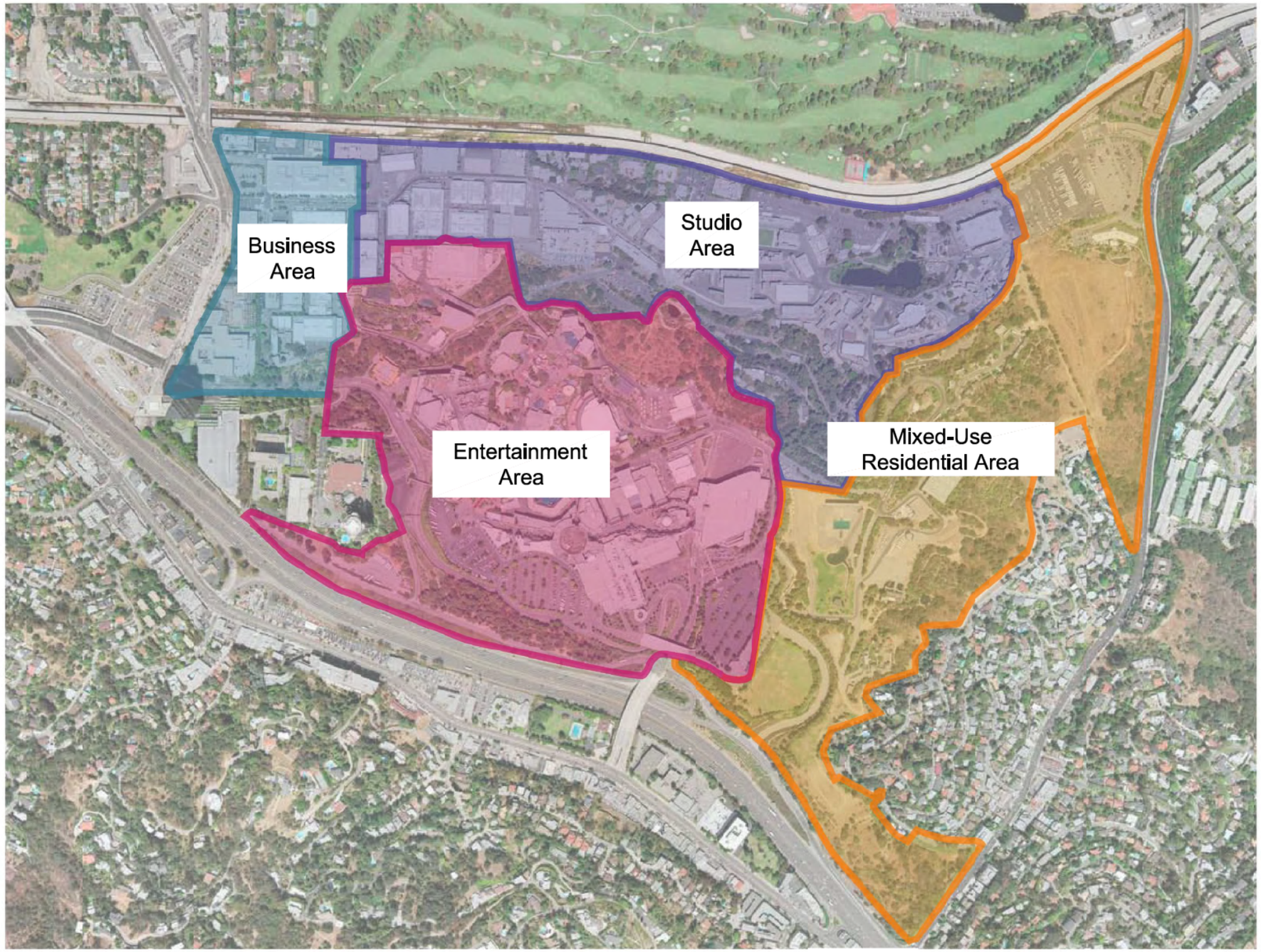
FIGURE 2



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AREA DIAGRAM

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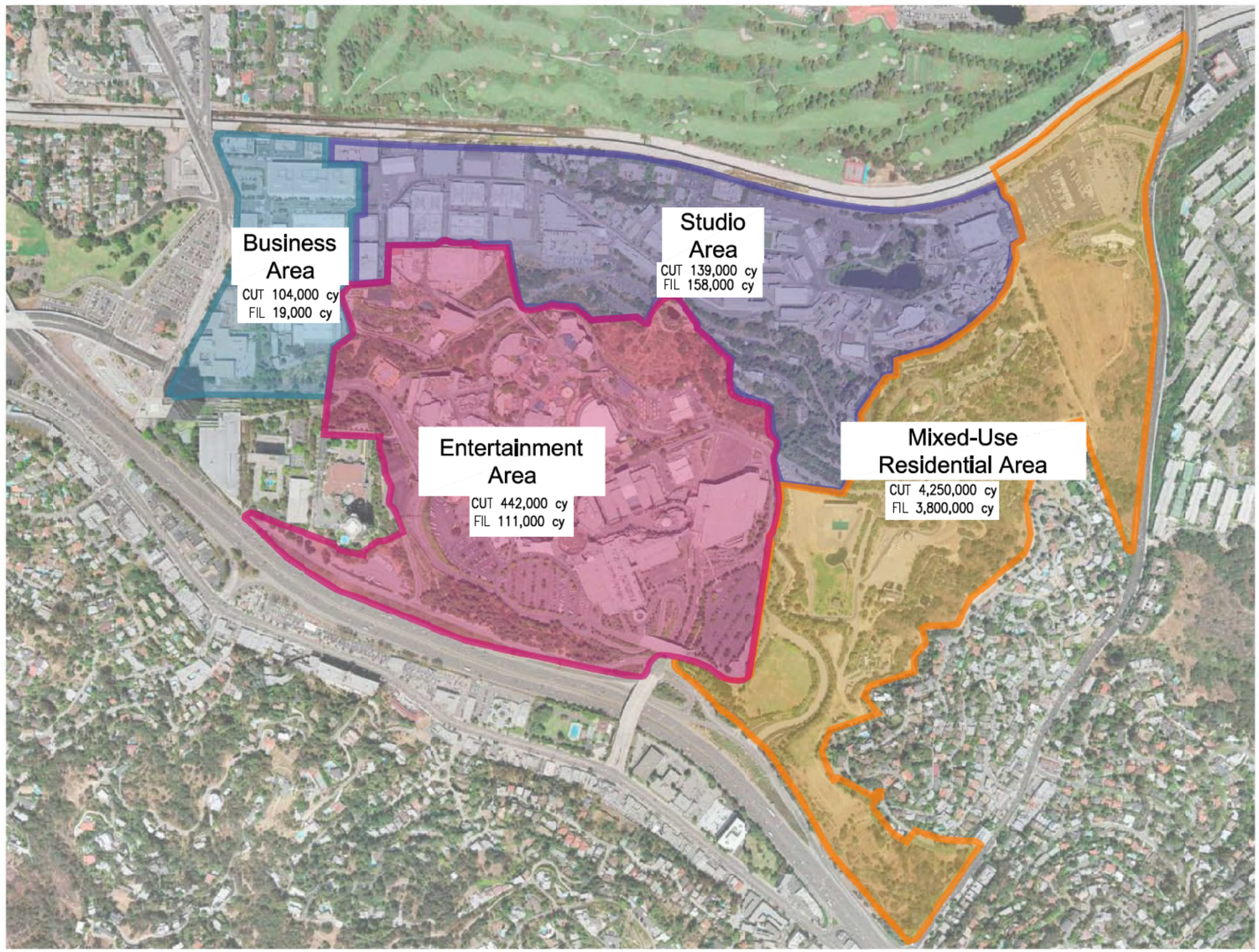
FIGURE 3



800' 400' 0 800' 1600'

GRAPHIC SCALE

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CONCEPTUAL GRADING PLAN

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FIGURE 4

EXPLANATION

GEOLOGIC UNITS

ef	ENGINEERED FILL
nef	NON-ENGINEERED FILL
Qal	ALLUVIUM
col	COLLUVIUM
Qls	LANDSLIDE DEBRIS
Tt	TOPANGA FORMATION interbedded sandstone, siltstone and shale
CLOSED LANDFILL	CLOSED LANDFILL

GEOLOGIC UNITS

- GEOLOGIC CONTACT DASHED WHERE APPROXIMATELY LOCATED, DOTTED WHERE BURIED
- BENEDICT CANYON FAULT (efter Dibblee, 1991) Dashed where approximate, dotted where inferred
- APPROXIMATE LIMITS OF LANDSLIDE DEBRIS
- APPROXIMATE LOCATION AND PLUNGE OF SYNCLINAL FOLD AXIS
- REPORTED LIMITS OF EXISTING BUTTRESS FILL
- CREEP AFFECTED SLOPE

N 161500
N 161000
N 160500
N 160000
N 159500

E 179500 E 180000 E 180500 E 182000 E 182500 E 183000 E 183500 E 184000 E 184500 E 185000

200' 100' 0' 200' 400'
GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches

REFERENCE: TOPOGRAPHIC MAP BY EIR SEPTEMBER 19 2007

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GEOTECHNICAL MAP

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FIGURE 5

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REGIONAL SEISMICITY MAP

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FIGURE 6

EXPLANATION

GEOLOGIC UNITS

- ef — ENGINEERED FILL
- nef — NON-ENGINEERED FILL
- Qal — ALLUVIUM
- col — COLLUVIUM
- Qls — LANDSLIDE DEBRIS
- Tt — TOPANGA FORMATION interbedded sandstone, siltstone and shale
- CLOSED LANDFILL — CLOSED LANDFILL

GEOLOGIC UNITS

- GEOLOGIC CONTACT DASHED WHERE APPROXIMATELY LOCATED, DOTTED WHERE BURIED
- BENEDICT CANYON FAULT (after Dibblee, 1991) Dashed where approximate, dotted where inferred
- APPROXIMATE LIMITS OF LANDSLIDE DEBRIS
- APPROXIMATE LOCATION AND PLUNGE OF SYNCLINAL FOLD AXIS
- REPORTED LIMITS OF EXISTING BUTTRESS FILL
- CREEP AFFECTED SLOPE

GEOTECHNICAL HAZARDS

- POTENTIAL SLOPE STABILITY HAZARD
- HIGH / MODERATE / LOW — LIQUEFACTION POTENTIAL ZONES
- NON-ENGINEERED FILL REMOVALS

N 161000
N 160500
N 160000
N 159500

E 178500 E 179000 E 179500 E 180000 E 180500 E 182000 E 182500 E 183000 E 183500 E 184000 E 184500 E 185000

200' 100' 0' 200' 400'
GRAPHIC SCALE
Note: For reduced sized prints, original scale is in inches

REFERENCE: TOPOGRAPHIC MAP BY EIR SEPTEMBER 19 2007

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GEOTECHNICAL HAZARDS MAP

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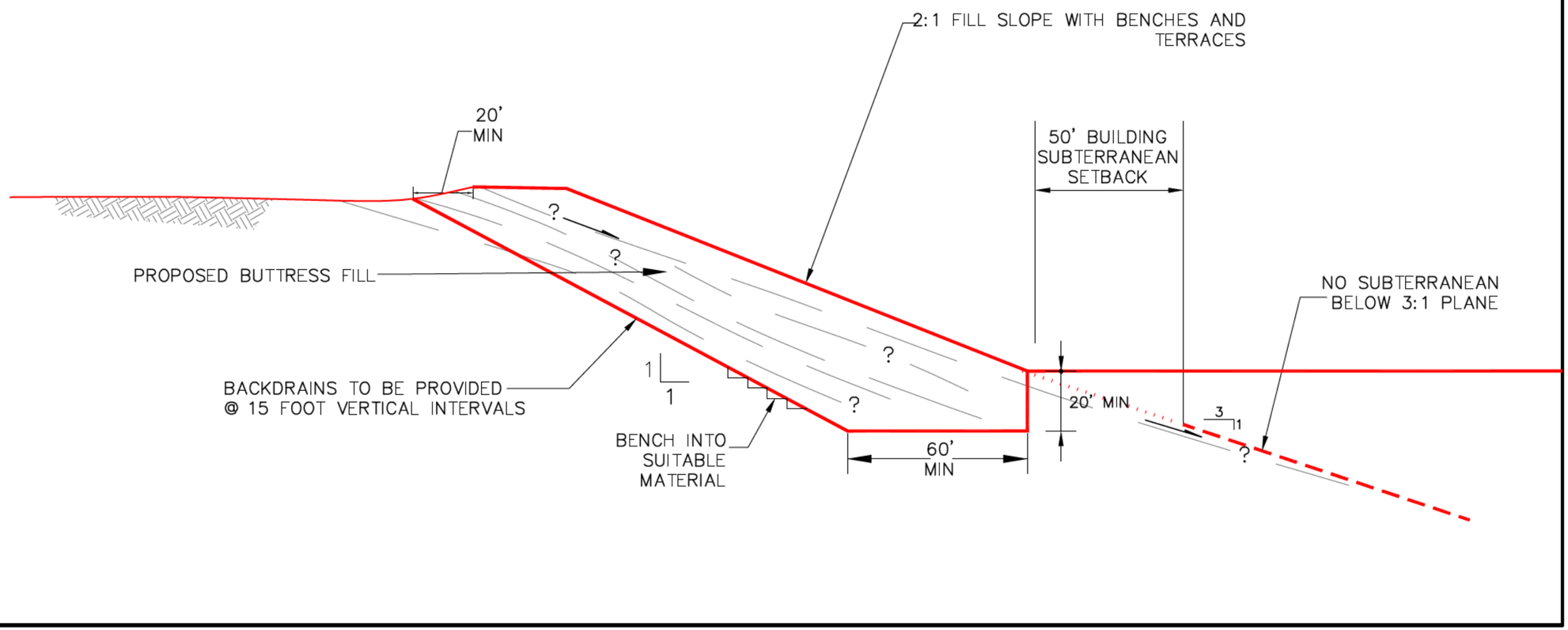
SHANNON & WILSON, INC. Geotechnical and Environmental Consultants | **FIGURE 7**



TYPICAL BUTTRESS FILL DESIGN CRITERIA
SCALE: 1"=40'

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TYPICAL BUTTRESS FILL DESIGN CRITERIA

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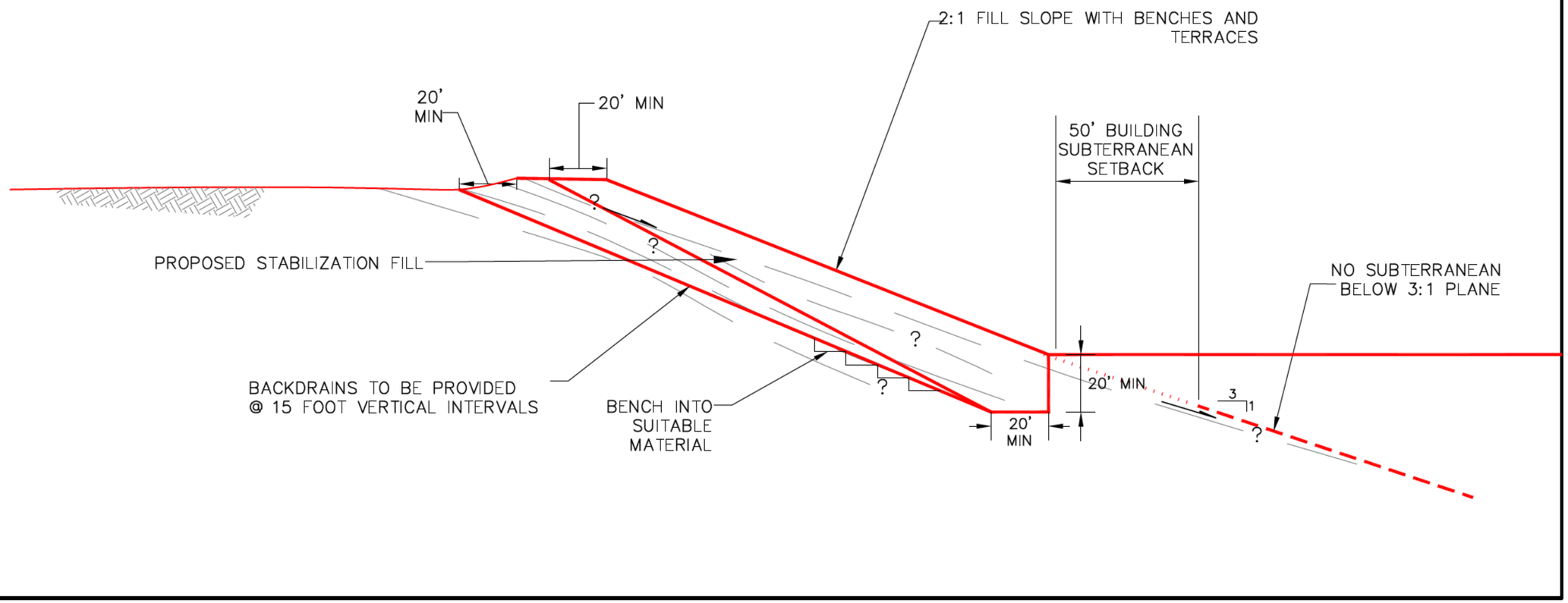
FIGURE 8



TYPICAL STABILIZATION FILL DESIGN CRITERIA
SCALE: 1"=40'

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Evolution Plan

TYPICAL STABILIZATION FILL DESIGN CRITERIA

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FIGURE 9